Case Study

TeXtreme® Spread Tow Fabrics Improves Composite Surface Smoothness

Spread Tow Fabrics could be considered one solution to obtaining increased surface smoothness leading to less print through and visual defects on composites. Through use of such reinforcement extra fillers, padding and thick gelcoats could be reduced leading to weight and labor savings. A case study on how the Finnish company Baltic Yachts successfully improved their composite hulls through using Spread Tow Fabrics is given herein.

Introduction

A composite surface's smoothness depends on many different factors. The types of reinforcement being used, the choice of resin, the manufacturing method and of course the curing parameters including temperatures, pressures and differences in curing cycles, etc. Surface distortions often become visible after a certain time as the composite is being exposed to unintended post cure. In the case study herein all parameters, except for the reinforcement structure, was kept constant and through this the influence of the reinforcement could be analyzed.

Surface smoothness of composites

When constructing composite materials it has often been noted that the surface displays a sort of orange peel pattern which often intensifies as the surface is being painted, especially if painted black. Numerous fillers, gelcoat systems and different curing cycles have been developed and investigated to reduce these defects. One way to minimize the easily seen large pattern print through which are created from bulky reinforcements is to use surface plies with low areal weight and hence very fine weave pattern for reduced fiber crimp and associated waviness. The magnitude of the print through with the use of low areal weight fabrics reduces but is still visibly large.

A case study in practice

It was during a discussion in 2009 between Håkan Sundelin from Baltic Yachts and Oxeon that the well recognized Finnish luxury composite sail boat manufacturer mentioned that their up to 200 feet long hulls sometimes displayed visible surface defects seen as print through. Mr. Sundelin said that these surface defects were often developed within 6-12 month during the assembly of the boats. To minimize the problem a variety of reinforcement structures and materials had been tested as the outer surface layer. The one displaying best results so far was a 200 gsm glass roving woven fabric followed by a 200 gsm carbon fiber roving woven cloth.

Baltic and Oxeon initiated a test program together where Oxeon supplied its 100 gsm TeXtreme® Spread Tow Fabric. Panels made with original layup stacking sequence using TeXtreme® and the two earlier known materials as surface layers were produced and stored in the assembly hall for 6 months to obtain the visual differences. At the following inspection Håkan Sundelin could clearly see the differences between the different panels. While the hull sections with the traditional yarn woven fabrics displayed uneven surface and imperfections, test samples made using Spread Tow Fabrics seemed to be much smoother.

"For a long time we had tried to optimize our manufacturing parameters and still not met an acceptable level of surface finish, mainly due to print through. The results when using TeXtreme as the surface ply showed dramatic improvements" says Håkan Sundelin.

Measurements and analysis

To quantify the differences in surface smoothness, especially the print through seen in this test, a test called OptiTopo was conducted. OptiTopo has been developed by Innventia AB (earlier STFI) wherein a camera and two light sources are used to optically detect the topography of a given surface. Tests can maximally be conducted on a 30 x 30 mm large area which was considered representative for all surface material structures.

The results shown in Fig 1 shows the topography of the surfaces of the different panels measured and displayed in height variations [µm].

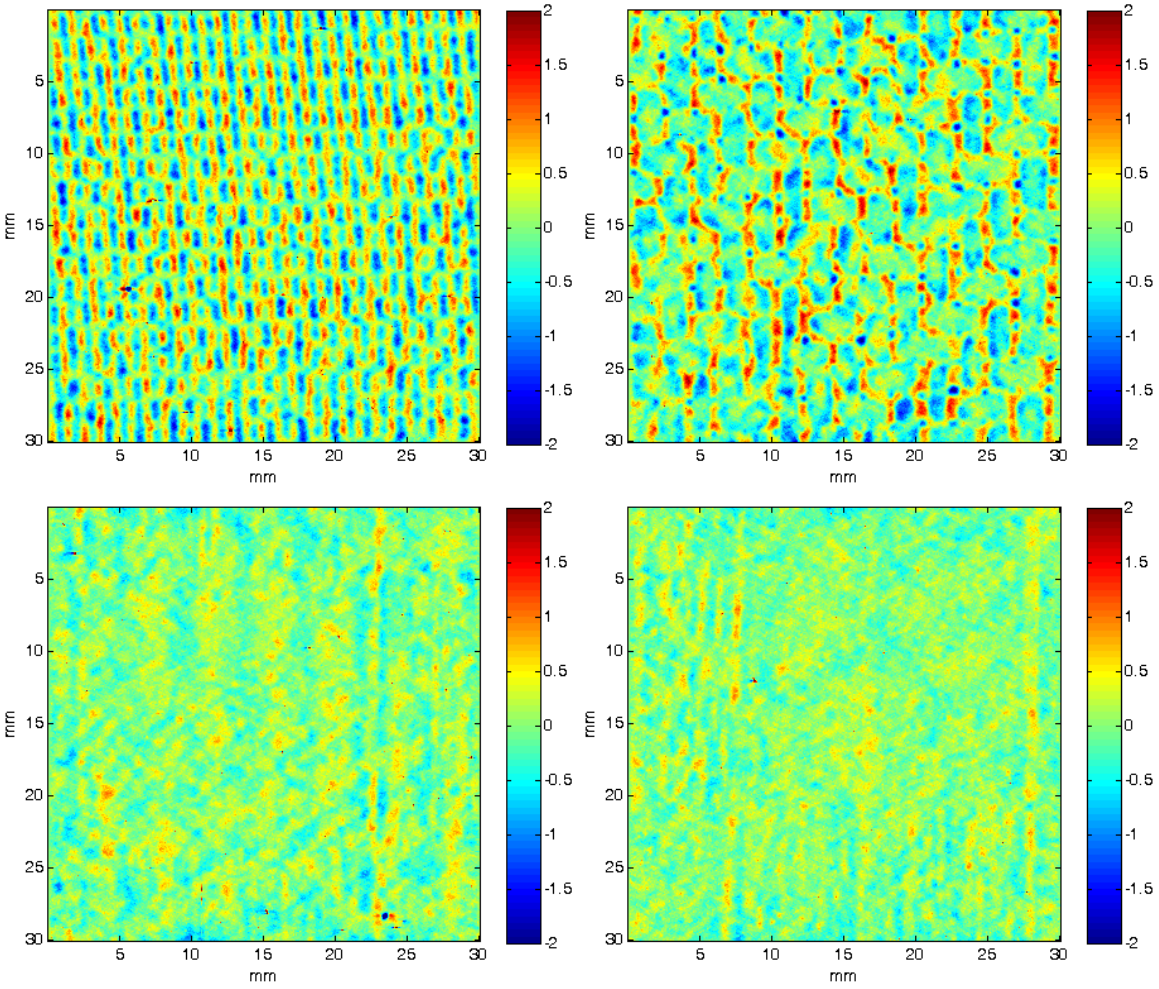

Fig 1. OptiTopo results: Upper left - 200 gsm glass roving fabric, upper right - 200 gsm carbon fiber roving woven cloth. Lower left - 100 gsm Spread Tow Fabric, lower right – 2 layers of 100 gsm Spread Tow Fabric. Color scale in µm.

The benefits of Spread Tow Fabrics

Oxeon produces and markets TeXtreme® ,the market leading Spread Tow Fabric,in a wide range of areal weights starting at 76 gsm from HS, IM and HM carbon fibers.

Spread Tow Fabrics are produced with virtually no in-plane or out of-plane fiber crimp and have relatively longer fiber floats leading to fewer interlacing points when compared to traditional yarn woven fabrics. Through this unique structure the resin rich valleys/pits are both relatively fewer and insignificant in size as can be seen in Fig 2.

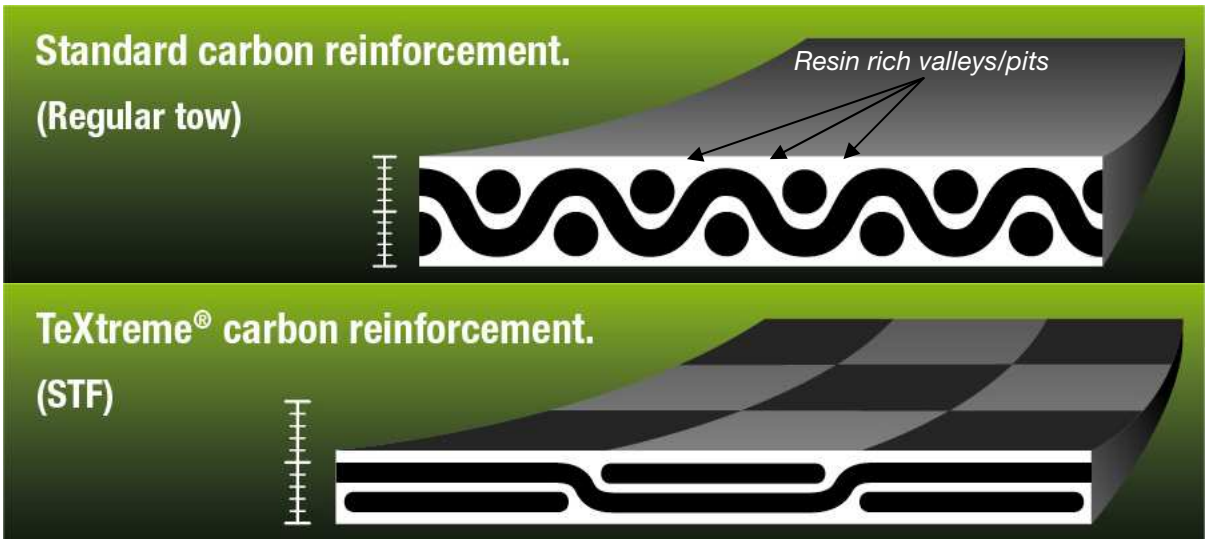

Fig 2. Spread Tow Fabrics (STF) reduces print through problem through its unique structure compared to standard carbon reinforcements.

Except for its unique ability to improve surface smoothness TeXtreme® also enables improved mechanical performance and great weight savings as the fibers are oriented relatively straighter and the fabric structure consumes less resin which reduces matrix dead weight.

Conclusion

TeXtreme® Spread Tow Fabric has shown to improve surface smoothness on composites with reduced print through as a result. The Case study shows that Finnish manufacturer Baltic Yachts were able to improve the surface smoothness on their composite sailboat hulls by switching to Spread Tow Fabrics for their surface ply. Lab test results from an OptiTopo analysis demonstrated and proved the surface smoothness improvements.